

Listing of Claims

Please amend the claims to the form set forth below.

Claims 1-72 (Canceled)

73. (previously presented) A method of producing a foamed material, said method comprising:

contacting a mixture comprising a first thermoplastic polymer and a second thermoplastic polymer with a blowing agent comprising a surfactant, wherein the surfactant is a copolymer selected from the group consisting of a graft copolymer, a block copolymer, and a random copolymer, wherein the first thermoplastic polymer has a higher percent crystallinity than the second thermoplastic polymer; and

subjecting the mixture to conditions sufficient to create a thermodynamic instability in the mixture to foam the mixture, the mixture comprising the first and second thermoplastic polymers having a percent crystallinity lower than the first thermoplastic polymer;

wherein the foamed material formed by said method has a plurality of distinct void spaces formed therein.

74. (previously presented) The method according to Claim 73, wherein the blowing agent is carbon dioxide.

75. (previously presented) The method according to Claim 74, wherein the carbon dioxide is liquid carbon dioxide.

76. (previously presented) The method according to Claim 74, wherein the carbon dioxide is supercritical carbon dioxide.

77. (previously presented) The method according to Claim 74, wherein at least one of the first and second thermoplastic materials is amorphous.

78. (previously presented) The method according to Claim 77, wherein the mixture of thermoplastic materials is amorphous.

79. (previously presented) The method according to Claim 74, wherein at least one of the first and second thermoplastic materials is semicrystalline.

80. (previously presented) The method according to Claim 74, wherein the first thermoplastic polymer is semicrystalline and the second thermoplastic material is amorphous.

81. (previously presented) The method according to Claim 80, wherein the mixture of thermoplastic materials is amorphous.

82. (previously presented) The method according to Claim 74, wherein the first and second thermoplastic polymers are each independently selected from the group consisting of PVDF, sPS, PTFE, PVC, Nylon (6,6), polyvinylmethylether, PP, PE, HDPE, PS, PMMA, polyisobutylene, PVA, PDMS, PEO, poly(phenylene oxide), PVF, PVDC, PVC, PVOH, PVAc, PC, ethyl acetate, PET, poly(ethylene naphthalate), poly(ϵ -caprolactone), poly(ether imide), chemical derivatives thereof, and mixtures thereof.

83. (previously presented) The method according to Claim 74, wherein the first thermoplastic polymer is selected from the group consisting of PVDF, sPS, PTFE, PVC, Nylon (6,6), polyvinylmethylether, PP, PE, HDPE, PVF, PVDC, PVOH, PVAc, PC, ethyl acetate, PET, poly(ethylene naphthalate), poly(ϵ -caprolactone), poly(ether imide), chemical derivatives thereof, and mixtures thereof; and the second thermoplastic polymer is selected from the group consisting of PS, PMMA, polyisobutylene, PVA, PDMS, PEO, poly(phenylene oxide), PC, chemical derivatives thereof, and mixtures thereof.

84. (previously presented) The method according to Claim 74, wherein the first thermoplastic polymer is PVDF and the second thermoplastic polymer is PMMA.

85. (previously presented) The method according to Claim 74, wherein said subjecting step comprises separating the mixture from the blowing agent to foam the mixture.

86. (previously presented) The method according to Claim 85, wherein said step of separating the mixture comprises venting the blowing agent.

87. (previously presented) The method according to Claim 74, wherein the blowing agent further includes a co-solvent.

88. (previously presented) The method according to Claim 74, wherein the blowing agent is carbon dioxide and the surfactant comprises a CO₂-philic segment.

89. (previously presented) The method according to Claim 88, wherein the CO₂-philic segment comprises a fluoropolymer.

90. (previously presented) The method according to Claim 88, wherein the CO₂-philic segment comprises a fluoropolymer formed from at least one monomer selected from the group consisting of fluoroacrylate monomers, fluoroolefin monomers, fluorostyrene monomers, fluoroalkylene oxide monomers, fluorinated vinyl alkyl ether monomers, and mixtures thereof.

91. (previously presented) The method according to Claim 74, wherein the surfactant comprises a CO₂-phobic segment.

92. (previously presented) The method according to Claim 91, wherein the CO₂-phobic segment is a polymer formed from at least one monomer selected from the group consisting of styrenics, α -olefins, ethylene oxides, dienes, amides, esters, sulfones, sulfonamides, imides, thiols, alcohols, diols, acids, ethers, ketones, cyanos, amines, quaternary ammonium salts, acrylates, methacrylates, thiozoles, and mixtures thereof.

93. (previously presented) The method according to Claim 74, wherein the blowing agent further includes a modifier selected from the group consisting of a reactant modifier, water, a plasticizing agent, an anti-bacterial agent, a toughening agent, a processing aid, a colorant, a dye, a flame retardant, and mixtures thereof.

94. (previously presented) The method according to Claim 74, wherein the blowing agent is selected from the group consisting of inorganic agents, organic blowing agents, and chemical blowing agents.

95. (previously presented) The method according to Claim 94, wherein the blowing agent is an inorganic blowing agent selected from the group consisting of carbon dioxide, nitrogen, argon, water, air nitrogen, and helium.

96. (previously presented) The method according to Claim 94, wherein the blowing agent is an organic blowing agent selected from the group consisting of aliphatic hydrocarbons having 1-9 carbon atoms, aliphatic alcohols having 1-3 carbon atoms, and fully and partially halogenated aliphatic hydrocarbons having 1-4 carbon atoms.

97. (previously presented) The method according to Claim 94, wherein the blowing agent is a chemical blowing agent selected from the group consisting of azodicarbonamide, azodiisobutyronitrile, benzenesulfonhydrazide, 4,4-oxybenzene sulfonylsemicarbazide, p-toluene sulfonyl semicarbazide, barium azodicarboxylate, N,N'-dimethyl-N,N'-dinitrosoterephthalamide, and trihydrazino triazine.

98. (previously presented) A method of extrusion processing a mixture of thermoplastic materials, said process comprising:

introducing at least two thermoplastic polymers into an extruder barrel, the at least two thermoplastic polymers comprising a first thermoplastic polymer and a second thermoplastic polymer, and wherein the first thermoplastic polymer has a higher percent crystallinity than the second thermoplastic polymer;

heating the mixture of thermoplastic materials to provide a molten blend thereof;

contacting the molten blend of thermoplastic materials with a blowing agent comprising at least one surfactant, wherein the surfactant is a copolymer selected from the group consisting of a graft copolymer; and

subjecting the blend to conditions sufficient to create a thermodynamic instability in the blend to foam the blend, wherein the foamed blend has a percent crystallinity lower than the first thermoplastic polymer;

wherein the foamed material formed by said method has a plurality of distinct void spaces formed therein.

99. (previously presented) The method according to Claim 98, wherein said step of contacting the molten blend of thermoplastic materials occurs in a mixing section of the extruder.

100. (previously presented) The method according to Claim 98, wherein said subjecting step comprises separating the blowing agent from the molten blend of thermoplastic polymers to form a foamed thermoplastic mixture.

101. (previously presented) The method according to Claim 100, wherein said step of separating the blowing agent from the blend comprises venting the blowing agent.

102. (previously presented) The method according to Claim 98, wherein the blowing agent is carbon dioxide.

103. (previously presented) The method according to Claim 102, wherein the carbon dioxide is liquid carbon dioxide.

104. (previously presented) The method according to Claim 102, wherein the carbon dioxide is supercritical carbon dioxide.

105. (previously presented) The method according to Claim 98, wherein at least one of the first and second thermoplastic materials is amorphous.

106. (previously presented) The method according to Claim 105, wherein the blend of thermoplastic materials is amorphous.

107. (previously presented) The method according to Claim 106, wherein at least one of the first and second thermoplastic materials is semicrystalline.

108. (previously presented) The method according to Claim 105, wherein the first thermoplastic polymer is semicrystalline and the second thermoplastic material is amorphous.

109. (previously presented) The method according to Claim 98, wherein the first thermoplastic polymer and the second thermoplastic polymer are each independently selected from the group consisting of PVDF, sPS, PTFE, PVC, Nylon (6,6), polyvinylmethylether, PP, PE, HDPE, PS, PMMA, polyisobutylene, PVA, PDMS, PEO, poly(phenylene oxide), PVF, PVDC, PVOH, PVAc, PC, poly(ethyl acetate), PET, poly(ethylene naphthalate), poly(ϵ -caprolactone), poly(ether imide), chemical derivatives thereof, and mixtures thereof.

110. (previously presented) The method according to Claim 98, wherein the first thermoplastic polymer is selected from the group consisting of PVDF, sPS, PTFE, PVC, Nylon (6,6), polyvinylmethylether, PP, PE, HDPE, PVF, PVDC, PVOH, PVAc, PC, poly(ethyl acetate), PET, poly(ethylene naphthalate), poly(ϵ -caprolactone), poly(ether imide), chemical derivatives thereof, and mixtures thereof; and the second thermoplastic polymer is selected from the group consisting of PS, PMMA, polyisobutylene, PVA, PDMS, PEO, poly(phenylene oxide), PC, chemical derivatives thereof, and mixtures thereof.

111. (previously presented) The method according to Claim 98, wherein the first thermoplastic polymer is PVDF and the second thermoplastic polymer is PMMA.

112. (previously presented) The method according to Claim 98, wherein the blowing agent further includes a co-solvent.

113. (previously presented) The method according to Claim 98, wherein the surfactant comprises a CO₂-philic segment.

114. (previously presented) The method according to Claim 113, wherein the CO₂-philic segment comprises a fluoropolymer

115. (previously presented) The method according to Claim 113, wherein the CO₂-philic segment comprises a fluoropolymer formed from at least one monomer selected from the group consisting of fluoroacrylate monomers, fluoroolefin monomers, fluorostyrene monomers, fluoroalkylene oxide monomers, fluorinated vinyl alkyl ether monomers, and mixtures thereof.

116. (previously presented) The method according to Claim 98, wherein the surfactant comprises a CO₂-phobic segment.

117. (previously presented) The method according to Claim 116, wherein the CO₂-phobic segment is a polymer formed from at least one monomer selected from the group consisting of styrenics, α -olefins, ethylene oxides, dienes, amides, esters, sulfones, sulfonamides, imides, thiols, alcohols, diols, acids, ethers, ketones, cyanos, amines, quaternary ammonium salts, acrylates, methacrylates, thiozoles, and mixtures thereof.

118. (previously presented) The method according to Claim 98, wherein the blowing agent further includes a modifier selected from the group consisting of a reactant modifier, water, a plasticizing agent, an anti-bacterial agent, a toughening agent, a processing aid, a colorant, a dye, a flame retardant, and mixtures thereof.

119. (previously presented) The method according to Claim 98, wherein the blowing agent is selected from the group consisting of inorganic agents, organic blowing agents, and chemical blowing agents.

120. (previously presented) The method according to Claim 119, wherein the blowing agent is an inorganic blowing agent selected from the group consisting of carbon dioxide, nitrogen, argon, water, air nitrogen, and helium.

121. (previously presented) The method according to Claim 119, wherein the blowing agent is an organic blowing agent selected from the group consisting of aliphatic hydrocarbons having 1-9 carbon atoms, aliphatic alcohols having 1-3 carbon atoms, and fully and partially halogenated aliphatic hydrocarbons having 1-4 carbon atoms.

122. (previously presented) The method according to Claim 119, wherein the chemical blowing agent is selected from the group consisting of azodicarbonamide, azodiisobutyronitrile, benzenesulfonhydrazide, 4,4-oxybenzene sulfonylsemicarbazide, p-toluene sulfonyl semicarbazide, barium azodicarboxylate, N,N'-dimethyl-N,N'-dinitrosoterephthalamide, and trihydrazino triazine.

Claims 123-148 (Canceled)

149. (previously presented) A method of producing a foamed material, said method comprising:

contacting a mixture comprising a first thermoplastic polymer and a second thermoplastic polymer with a blowing agent comprising a surfactant, wherein the surfactant is a copolymer selected from the group consisting of a graft copolymer, a block copolymer, and a random copolymer, wherein the first thermoplastic polymer has a higher percent crystallinity than the second thermoplastic polymer; and

subjecting the mixture to conditions sufficient to create a thermodynamic instability in the mixture to foam the mixture, the mixture comprising the first and second thermoplastic polymers having a percent crystallinity lower than the first thermoplastic polymer;

wherein the foamed material formed by said method has a plurality of distinct void spaces formed therein having an average size ranging from about 0 to about 500 microns.

150. (previously presented) The method according to Claim 149, wherein the plurality of distinct void spaces formed therein have an average size ranging from about 1 to about 100 microns.

151. (previously presented) The method according to Claim 149, wherein the plurality of distinct void spaces formed therein have an average size ranging from about 0.1 to about 50 microns.

152. (previously presented) The method according to Claim 151, wherein the mixture of thermoplastic materials is amorphous.

153. (previously presented) The method according to Claim 152, wherein the first thermoplastic material is PVDF and the second thermoplastic material is PMMA.

154. (previously presented) A method of extrusion processing a mixture of thermoplastic materials, said process comprising:

introducing at least two thermoplastic polymers into an extruder barrel, the at least two thermoplastic polymers comprising a first thermoplastic polymer and a second thermoplastic polymer, and wherein the first thermoplastic polymer has a higher percent crystallinity than the second thermoplastic polymer;

heating the mixture of thermoplastic materials to provide a molten blend thereof;

contacting the molten blend of thermoplastic materials with a blowing agent comprising at least one surfactant, wherein the surfactant is a copolymer selected from the group consisting of a graft copolymer; and

subjecting the blend to conditions sufficient to create a thermodynamic instability in the blend to foam the blend, wherein the foamed blend has a percent crystallinity lower than the first thermoplastic polymer;

wherein the foamed material formed by said method has a plurality of distinct void spaces formed therein having an average size ranging from above about 0 to about 500 microns.

155. (previously presented) The method according to Claim 154, wherein the plurality of distinct void spaces formed therein have an average size ranging from about 1 to about 100 microns.

156. (previously presented) The method according to Claim 154, wherein the plurality of distinct void spaces formed therein have an average size ranging from about 0.1 to about 50 microns.

157. (previously presented) The method according to Claim 156, wherein the blend of thermoplastic materials is amorphous.

158. (previously presented) The method according to Claim 157, wherein the first thermoplastic material is PVDF and the second thermoplastic material is PMMA.